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(54) **TONER, TONER SET, TONER ACCOMMODATING UNIT, IMAGE FORMING APPARATUS, AND IMAGE FORMING METHOD**

TONER, TONERSATZ, TONERAUFNAHMEEINHEIT, BILDERZEUGUNGSVORRICHTUNG UND BILDERZEUGUNGSVERFAHREN

TONER, ENSEMBLE TONER, UNITÉ DE LOGEMENT DE TONER, APPAREIL DE FORMATION D'IMAGES ET PROCÉDÉ DE FORMATION D'IMAGES

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(56) References cited:
JP-A- 2004 051 753 **JP-A- 2009 057 487**
JP-A- 2009 179 756

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Description

BACKGROUND

Technical Field

[0001] The present disclosure relates to a toner, a toner set, a toner accommodating unit, an image forming apparatus, and an image forming method.

Description of the Related Art

[0002] An electrophotographic method is an image forming method to form a visible image by developing an electrostatic latent image with a developer. Specifically, an electrostatic latent image is formed on an electrostatic latent image bearer (also referred to as "photoconductor") containing a photoconductive substance, then the electrostatic latent image is developed with a developer containing toner to form a toner image, and the toner image is transferred onto a recording medium such as a paper sheet and fixed thereon by heat and pressure to form a fixed image.

[0003] To form a full-color image by the electrophotographic method, a toner set containing black toner in combination with cyan, magenta, and yellow toners, which are toners of three process colors, is generally used.

[0004] In recent years, as electrophotographic color image forming apparatuses have become widespread, the uses of the printed products thereof have been diversified. Particularly in the field of custom-designed general consumer goods, there is an increasing need for an electrophotographic printing method that makes it possible to make print on materials which have been unable to make print with conventional electrophotographic toners that are designed to be printed on paper media. For example, there is a need for printing on recording media made of cloth ("cloth media") such as uniforms, shoes, and bags for athletics teams.

[0005] To be fixed on such cloth media, toner is required to be fixable on cloth fibers having a high degree of irregularity. The fixed toner layer is required to be able to follow deformation of the cloth with an appropriate flexibility. Toner is thus required to have properties that have not been required when fixed on conventional paper media. JP-2004-51753-A proposes to make a print on a film, which is a readily-deformable recording medium, with a toner containing a pigment and a polyester-based plasticizer having a glass transition temperature of -10 degrees C or lower. However, the proposed toner does not meet the requirements for being printed on the cloth. None of the conventional toners has met such requirements.

[0006] An object of the present invention is to provide a toner that forms a fixed image having no image unevenness, excellent blocking resistance, and high washing fastness.

[0007] JP-A-2004-051753 discloses a white toner prepared by uniformly dispersing a white pigment and a polyester plasticizer having a glass transition temperature of -10 ° C or less, and the white pressure-sensitive adhesive composition obtained by mixing the white toner and the pressure-sensitive adhesive is used for a decorative pressure-sensitive adhesive sheet.

SUMMARY

[0008] In accordance with some embodiments of the present invention, a toner is provided that forms a fixed image having no image unevenness, excellent blocking resistance, and high washing fastness.

[0009] The invention is set out in the appended set of claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A more complete appreciation of the disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic diagram illustrating an image forming apparatus according to an embodiment of the present invention;

FIG. 2 is a schematic diagram illustrating a main part of the image forming apparatus; and

FIG. 3 is a schematic diagram illustrating another image forming apparatus according to an embodiment of the present invention.

[0011] The accompanying drawings are intended to depict example embodiments of the present invention and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale

unless explicitly noted.

DETAILED DESCRIPTION

[0012] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0013] Embodiments of the present invention are described in detail below with reference to accompanying drawings. In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific terminology so selected, and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0014] For the sake of simplicity, the same reference number will be given to identical constituent elements such as parts and materials having the same functions and redundant descriptions thereof omitted unless otherwise stated.

Toner

[0015] The toner according to an embodiment of the present invention contains a binder resin, and preferably further contains an adhesive agent as claimed.

[0016] The toner may further optionally contain other components as necessary.

[0017] The glass transition temperature (Tg) of the toner is -5 degrees C or higher and 5 degrees C or lower.

Binder Resin

[0018] The binder resin is not particularly limited, and any of conventionally known resins can be used. Examples of the binder resin include, but are not limited to, styrene-based resins such as styrene, α-methylstyrene, chlorostyrene, styrene-propylene copolymer, styrenebutadiene copolymer, styrene-vinyl chloride copolymer, styrene-vinyl acetate copolymer, styrene-maleic acid copolymer, styrene-acrylate copolymer, styrene-methacrylate copolymer, and styrene-acrylonitrile-acrylate copolymer, polyester resins, vinyl chloride resins, rosin-modified maleic acid resins, phenol resins, epoxy resins, polyethylene resins, polypropylene resins, ionomer resins, polyurethane resins, silicone resins, ketone resins, xylene resins, petroleum resins, and hydrogenated petroleum resins. Each of these can be used alone or in combination with others. Among these, styrene-based resins containing aromatic compounds as constitutional units and polyester resins are preferred, and polyester resins are more preferred.

[0019] The polyester resin may be obtained by a polycondensation reaction between commonly known alcohols and acids.

[0020] Specific examples of the alcohols include, but are not limited to: diols such as polyethylene glycol, diethylene glycol, triethylene glycol, 1,2-propylene glycol, 1,3-propylene glycol, 1,4-propylene glycol, neopentyl glycol, and 1,4-butenediol; etherified bisphenols such as 1,4-bis(hydroxymethyl)cyclohexane, bisphenol A, hydrogenated bisphenol A, polyoxyethylenated bisphenol A, and polyoxypropylenated bisphenol A; divalent alcohol monomers obtained by substituting the above compounds with a saturated or unsaturated hydrocarbon group having 3 to 22 carbon atoms; other divalent alcohol monomers; and trivalent or higher alcohol monomers such as sorbitol, 1,2,3,6-hexanetetraol, 1,4-sorbitan, pentaerythritol, dipentaerythritol, tripentaerythritol, sucrose, 1,2,4-butanetriol, 1,2,5-pentanetriol, glycerol, 2-methylpropanetriol, 2-methyl-1,2,4-butanetriol, trimethylolethane, trimethylolpropane, and 1,3,5-trihydroxymethylbenzene. Each of these can be used alone or in combination with others.

[0021] The acids are not particularly limited and can be suitably selected to suit to a particular application, but carboxylic acids are preferred.

[0022] Specific examples of the carboxylic acids include, but are not limited to: monocarboxylic acids such as palmitic acid, stearic acid, and oleic acid; maleic acid, fumaric acid, mesaconic acid, citraconic acid, terephthalic acid, cyclohexanedicarboxylic acid, succinic acid, adipic acid, sebacic acid, and malonic acid, and divalent organic acid monomers obtained by substituting these acids with a saturated or unsaturated hydrocarbon group having 3 to 22 carbon atoms; anhydrides of these acids; dimers of lower alkyl esters and linolenic acid; 1,2,4-benzenetricarboxylic acid, 1,2,5-benzenetricarboxylic acid, 2,5,7-naphthalenetricarboxylic acid, 1,2,4-naphthalenetricarboxylic acid, 1,2,4-butanetricarboxylic acid, 1,2,5-hexanetricarboxylic acid, 1,3-dicarboxyl-2-methyl-2-methylenecarboxypropane, tetra(methylenecarboxyl)methane, 1,2,7,8-octanetetracarboxylic acid, and enpol trimer acid; and trivalent or higher polyvalent carboxylic acid monomers such as anhydrides of the above acids. Each of these can be used alone or in combination with others.

[0023] The method for producing the binder resin is not particularly limited and can be suitably selected to suit to a particular application. Examples of thereof include, but are not limited to, bulk polymerization, solution polymerization, emulsion polymerization, and suspension polymerization.

Adhesive Agent

[0024] The inventors of the present invention have found that a toner containing an adhesive agent is remarkably improved in fixability on cloth recording media and the fixed toner layer is imparted with appropriate flexibility.

[0025] The toner contains at least one adhesive agent selected from polyethylene terephthalate, polyethylene isophthalate, polybutylene terephthalate, and polybutylene isophthalate. Each of these can be used alone or in combination with others. Preferably, the toner contains at least one of polyethylene terephthalate and polybutylene terephthalate as a main component, for imparting flexibility.

[0026] The adhesive agent may be either a synthesized product or a commercially available product. Examples of the commercially available product include, but are not limited to, hot melt adhesives PES-120L, PES-140H, PES-111EE, and PES-126EH (all manufactured by Toagosei Co., Ltd.).

[0027] The glass transition temperature of the adhesive agent is preferably -5 degrees C or higher and 5 degrees C or lower. When the glass transition temperature is -5 degrees C or higher, the toner is prevented from undergoing a significant deterioration of heat-resistant storability. When the glass transition temperature is +5 degrees C or lower, the fixed toner layer is prevented from lacking flexibility.

[0028] A 1/2 outflow temperature of the adhesive agent is preferably 80 degrees C or higher and 200 degrees C or lower. When the 1/2 outflow temperature is 80 degrees C or higher, the fixed toner image is prevented from melting out when ironed. When the 1/2 outflow temperature is 200 degrees C or lower, it does not become difficult to melt-knead toner components and the adhesive agent in the process of producing the toner.

[0029] The 1/2 outflow temperature is measured using a flowtester (CFT-500D manufactured by Shimadzu Corporation) as follows. First, 1.0 g of a sample is applied with a load of 1.96 MPa by a plunger while being heated at a temperature rising rate of 6 degrees C/min and extruded from a nozzle having a diameter of 1.0 mm and a length of 1.0 mm. The amount of decent of the plunger of the flowtester is plotted against the temperature, and the temperature at which the half of the sample has flowed out is taken as the 1/2 outflow temperature.

[0030] The weight average molecular weight of the adhesive agent is preferably from 40,000 to 150,000. When the weight average molecular weight is 40,000 or higher, the fixed toner image is prevented from melting out when ironed. When the weight average molecular weight is 150,000 or lower, it does not become difficult to melt-knead toner components and the adhesive agent in the process of producing the toner.

[0031] The weight average molecular weight of the adhesive agent is determined from a molecular weight distribution of THF-soluble matter as measured with a GPC (gel permeation chromatography) measuring instrument GPC-150C (manufactured by Waters Corporation).

[0032] The measurement is conducted using columns (SHODEX KF 801 to 807 manufactured by Showa Denko K.K.) as follows. The columns are stabilized in a heat chamber at 40 degrees C. Tetrahydrofuran (THF) as a solvent is let to flow in the columns at that temperature at a flow rate of 1 mL per minute. Next, 0.05 g of a sample is thoroughly dissolved in 5 g of THF and filtered with a pretreatment filter (e.g., a chromatographic disk having a pore size of 0.45 μm, manufactured by KURABO INDUSTRIES LTD.) to prepare a THF solution of the sample having a sample concentration of from 0.05% to 0.6% by weight, and 50 to 200 μL thereof is injected in the measuring instrument.

[0033] The weight average molecular weight Mw of the sample is determined by comparing the molecular weight distribution of the sample with a calibration curve created with several types of monodisperse polystyrene standard samples that shows the relation between the logarithmic values of molecular weights and the number of counts.

[0034] The polystyrene standard samples for creating the calibration curve may be those having molecular weights of 6×10^2, 2.1×10^2, 4×10^2, 1.75×10^4, 5.1×10^4, 1.1×10^5, 3.9×10^5, 8.6×10^5, 2×10^6, and 4.48×10^6, respectively, manufactured by Pressure Chemical Co. or Toyo Soda Manufacturing Co., Ltd (now Tosoh Corporation). Preferably, about 10 standard polystyrene samples are used.

[0035] As the detector, a refractive index (RI) detector is used.

Method of Analyzing Structure of Adhesive Agent in Toner

[0036] The structure of the adhesive agent in the toner can be specified in the following manner.

[Specimen Treatment]

[0037] The toner is dispersed in chloroform and stirred overnight. Subsequently, the resultant dispersion liquid is centrifuged, and only the supernatant is collected. The collected supernatant is evaporated to dryness, thus preparing

a sample to be subjected to a composition analysis by GC-MS.

[0038] About 1 μL of a methylating agent (20% methanol solution of tetramethylammonium hydroxide (TMAH)) is dropped into about 1 mg of the sample, thus preparing a specimen.

[Measurement]

[0039]

Pyrolysis-gas chromatography-mass spectrometer (Py-GCMS)
Analyzer: QP2010 manufactured by Shimadzu Corporation
Heating furnace: Py2020D manufactured by Frontier Laboratories Ltd.
Heating temperature: 320 degrees C
Column: Ultra ALLOY-5, L = 30 m, ID = 0.25 mm, Film = 0.25 μm
Column temperature: 50 degrees C (held for 1 minute) -> temperature rise (at 10 degrees C/min) -> 340 degrees C (held for 7 minutes)
Split ratio: 1:100
Column flow rate: 1.0 mL/min
Ionization method: EI method (70 eV)
Measurement mode: Scan mode
Search data: NIST 20 MASS SPECTRAL LIB.

[0040] The structure of the adhesive agent in the toner can also be specified in the following manner.

[Specimen Preparation]

[0041] The toner is dispersed in chloroform and stirred overnight. Subsequently, the resultant dispersion liquid is centrifuged, and only the supernatant is collected. The collected supernatant is evaporated to dryness, thus preparing a sample to be subjected to a composition analysis by NMR (nuclear magnetic resonance).

(1) For ^{1}H-NMR To the above-prepared sample in an amount of 100 mg, 1 mL of d8-toluene is added and heated by a dryer to be dissolved therein, thus preparing a specimen for ^{1}H-NMR measurement.
(2) For ^{13}C-NMR To the above-prepared sample in an amount of 100 mg, 1 mL of deuterated 1,2-dichlorotoluene is added and heated by a dryer to be dissolved therein, thus preparing a specimen for ^{13}C-NMR measurement.

[Analysis Instruments and Measurement Conditions]

[0042] NMR equipment: ECX-500 manufactured by JEOL Ltd.

(1) Measurement nucleus = ^{1}H (500 MHz), measurement pulse file = single pulse dec.jxp (1H), 45 deg. C pulse, integration = 20,000 times, relaxation delay = 4 seconds, data point = 32K, offset = 100 ppm, observation width = 250 ppm, measurement temperature = 70 deg. C
(2) Measurement nucleus = ^{13}C (125 MHz), measurement pulse file = single pulse dec.jxp (13C), 45 deg. C pulse, integration = 64 times, relaxation delay = 5 seconds, data point = 32K, observation width = 15 ppm, measurement temperature = 65 deg. C

[0043] The proportion of the adhesive agent in the toner is preferably 10% by mass or more and 50% by mass or less. When the proportion is 10% by mass or more, the fixability of the toner on cloth media is sufficient. When the proportion is 50% by mass or less, the toner is prevented from deteriorating in heat-resistant storability, and the occurrence of aggregation of the toner particles is prevented.

Other Components

[0044] The toner may further contain other components which are not particularly limited and can be suitably selected to suit to a particular application, as long as they are usable for ordinary toners. Examples thereof include, but are not limited to, a colorant, a wax, a charge controlling agent, and an external additive. Each of these may be used alone or two or more of these may be used in combination.

Colorant

[0045] The colorant is not particularly limited and may be selected to suit to a particular application as long as it is usable for ordinary toners. Examples of the colorant include, but are not limited to, black colorants, cyan colorants, magenta colorants, yellow colorants, green colorants, blue colorants, and white pigments. Each of these can be used alone or in combination with others.

[0046] Examples of the black colorants include, but are not limited to, carbon black alone, and a mixture of carbon black as a main component with copper phthalocyanine, whose hue and lightness have been adjusted.

[0047] Examples of the cyan colorants include, but are not limited to, copper phthalocyanine (Pigment Blue 15:3) and a mixture of the copper phthalocyanine with aluminum phthalocyanine.

[0048] Examples of the magenta colorants include, but are not limited to, Pigment Red 53:1, Pigment Red 81, Pigment Red 122, and Pigment Red 269.

[0049] Examples of the yellow colorants include, but are not limited to, Pigment Yellow 74, Pigment Yellow 155, Pigment Yellow 180, and Pigment Yellow 185. Among these, Pigment Yellow 185 alone and a mixture of Pigment Yellow 185 and Pigment Yellow 74 are preferred for saturation and storability.

[0050] Examples of the green colorants include, but are not limited to, Pigment Green 7.

[0051] Examples of the blue colorants include, but are not limited to, Pigment Blue 15:1 and Pigment Violet 23.

[0052] Examples of the white pigments include, but are not limited to, titanium dioxide which is surface-treated with silicon, zirconia, aluminum, or polyol.

Wax

[0053] The wax is not particularly limited and can be suitably selected to suit to a particular application. Examples thereof include, but are not limited to, aliphatic hydrocarbons such as liquid paraffin, micro-crystalline wax, natural paraffin, synthetic paraffin, and polyolefin wax, and partial oxides, fluorides, and chlorides thereof; animal oils such as beef tallow and fish oil; vegetable oils such as coconut oil, soybean oil, rapeseed oil, rice bran wax, and carnauba wax; higher aliphatic alcohols and higher fatty acids such as montan wax; fatty acid amides and fatty acid bisamides; metal soaps such as zinc stearate, calcium stearate, magnesium stearate, aluminum stearate, zinc oleate, zinc palmitate, magnesium palmitate, zinc myristate, zinc laurate, and zinc behenate; fatty acid esters; and polyvinylidene fluoride. Each of these can be used alone or in combination with others. In particular, the wax preferably comprises at least an ester wax such as a fatty acid ester.

[0054] The proportion of the wax in the toner is preferably 0.1% by mass or more and 8.0% by mass or less. When the proportion is 0.1% by mass or more, the occurrence of waste sheet jam, caused when the toner and the fixing roller (or fixing belt) cannot be separated from each other at the time of fixing the toner, is prevented. When the proportion is 8.0% by mass or more, the fixability of the toner on cloth media is sufficient.

Charge Controlling Agent

[0055] The charge controlling agent is not particularly limited and can be suitably selected to suit to a particular application as long as it is usable for ordinary toners. Examples of the charge controlling agent include, but are not limited to: nigrosine and modified products with fatty acid metal salts; onium salts such as phosphonium salt and lake pigments thereof; triphenylmethane dyes and lake pigments thereof; metal salts of higher fatty acids; diorganotin oxides such as dibutyltin oxide, dioctyltin oxide, and dicyclohexyltin oxide; diorganotin borates such as dibutyltin borate, dioctyltin borate, and dicyclohexyltin borate; organometallic complexes, chelate compounds, monoazo metal complexes, acetylacetone metal complexes, aromatic hydroxycarboxylic acids, metal complexes of aromatic dicarboxylic acids, and quaternary ammonium salts.

[0056] Examples of the charge controlling agent further include aromatic hydroxycarboxylic acids, aromatic mono- and poly- carboxylic acids and metal salts, anhydrides, and esters thereof, and phenol derivatives such as bisphenol. Each of these can be used alone or in combination with others.

[0057] The amount of the charge controlling agent is preferably from 0.1 to 10 parts by mass with respect to the entire binder resin. To prevent undesirable coloring of the toner, a colorless material is preferably selected for the charge controlling agent except for the case of black toner.

External Additive

[0058] Preferred examples of the external additive include inorganic particles. Specific examples of the inorganic particles include, but are not limited to, silica, alumina, titanium oxide, barium titanate, magnesium titanate, calcium titanate, strontium titanate, zinc oxide, silica sand, clay, mica, wollastonite, diatomaceous earth, chromium oxide, cerium

oxide, red iron oxide, antimony trioxide, magnesium oxide, zirconium oxide, barium sulfate, barium carbonate, calcium carbonate, silicon carbide, and silicon nitride. Among these, silica, alumina, and titanium oxide are preferred.

[0059] The inorganic particles may be those treated with a surface treatment agent such as a hydrophobizing agent. Examples of the hydrophobizing agent include, but are not limited to, silane coupling agents, silylation agents, silane coupling agents having a fluorinated alkyl group, organic titanate coupling agents, and aluminum coupling agents. Also, silicone oils are also effective as the hydrophobizing agent.

[0060] The primary particles of the inorganic particles preferably have an average particle diameter of from 5 to 500 nm, more preferably from 5 to 200 nm. When the average particle diameter is 5 nm or more, the occurrence of aggregation of the inorganic particles is prevented to prevent the inorganic particles from being non-uniformly dispersed in the toner. When the average particle diameter is 500 nm or less, heat-resistant storage stability does not deteriorate due to a filler effect. Here, the average particle diameter is directly determined from a photograph of particles obtained with a transmission electron microscope. Preferably, the average particle diameter is the average value of long diameters of at least 100 or more particles observed.

Glass Transition Temperature (Tg)

[0061] The glass transition temperature (Tg) of the toner is -5 degrees C or higher and 5 degrees C or lower, more preferably -1 degree C or higher and 1 degree C or lower. When the glass transition temperature is lower than -5 degrees C, the toner may undergo a significant deterioration of heat-resistant storability. When the glass transition temperature is higher than 5 degrees C, the fixed toner layer may lack flexibility.

[0062] When the glass transition temperature of the toner is -5 degrees C or higher and 5 degrees C or lower, the toner is prevented from undergoing a significant deterioration of heat-resistant storability and from lacking flexibility.

[0063] The glass transition temperature (Tg) is measured using a differential scanning calorimeter (DSC210 manufactured by Seiko Instruments & Electronics Ltd.) by weighing 0.01 to 0.02 g of a sample in an aluminum pan at room temperature, then cooling the sample to -20 degrees C at a temperature falling rate of 10 degrees C/min, and heating the sample to 200 degrees C at a temperature rising rate of 10 degrees C/min. The glass transition temperature (Tg) is determined as a temperature at the intersection of an extended line of a base line of the resulted endothermic curve, and a tangent line of the endothermic curve which indicates the maximum slope between the peak rising portion and the peak top.

Number-Based Particle Diameter Distribution

[0064] Preferably, the number-based particle diameter distribution of the toner has at least two peaks.

[0065] More preferably, the at least two peaks include a peak in a number-based particle diameter range of from 12 to 16 μm and another peak in a number-based particle diameter range of from 5 to 8 μm.

[0066] As the particle diameter of the toner increases, the pile height of the toner layer (i.e., the thickness of the toner layer in which toners of several colors are superposed) increases, making it easy to level irregularities on the cloth surface. To balance the easiness in leveling irregularities on the cloth surface and the transferability of the toner, which are in a trade-off relationship, the toner preferably comprises large-particle-diameter toner particles and small-particle-diameter toner particles. The peak on the larger particle side among the two peaks, which is derived from the large-particle-diameter toner particles, preferably have a number-based particle diameter in the range of from 12 to 16 μm.

[0067] The small-particle-diameter toner particles have a number-based particle diameter in the range of from 5 to 8 μm, and are used to broaden the particle diameter distribution of the toner. This makes it possible to increase the transferability of the large-particle-diameter toner particles that have poor transferability. It is also possible to fill the gap between the large-particle-diameter toner particles with the small-particle-diameter toner particles, thereby smoothening the surface of the toner layer while ensuring the pile height.

[0068] The small-particle-diameter toner particles and the large-particle-diameter toner particles may have the same or different compositions. Preferably, toner particles having a peak in the number-based particle diameter range of from 12 to 16 μm have a glass transition temperature in the range of from -5 to +5 degrees C and are colorless, for securing good fixability of the toner on cloth media and flexibility of the fixed layer of the toner.

[0069] The number-based particle diameter distribution is measured using a particle size analyzer (MULTISIZER III manufactured by Beckman Coulter, Inc.) with setting the aperture diameter to 100 μm and analyzed with an analysis software program (Beckman Colter Multisizer 3 Version 3.51). Specifically, 0.5 mL of a 10% by weight aqueous solution of a surfactant (an alkylbenzene sulfonate, NEOGEN SC-A manufactured by DKS Co., Ltd.) is put in a 100-mL glass beaker, then 0.5 g of the toner is added thereto and mixed using a micro spatula, and 80 mL of ion-exchange water is further added thereto. The resulting dispersion liquid is subjected to a dispersion treatment using an ultrasonic disperser (W-113MK-II manufactured by HONDA ELECTRONICS CO., LTD.) for 10 minutes. The dispersion liquid is measured using the MULTISIZER III and ISOTON III (manufactured by Beckman Coulter, Inc.) as a solution for measurement. In

the measurement, the toner sample dispersion liquid is dropped so that the concentration indicated by the apparatus becomes 8±2%. In this measurement, the concentration is adjusted to 8±2% for the measurement reproducibility of particle diameter. Within this concentration range, no error occurs in the measurement of the particle diameter.

[0070] When the toner of the present disclosure is used to form a base layer (i.e., a layer closest to the recording medium) and an upper layer is formed thereon with the conventional toner, the conventional toner can also be satisfactorily fixed on cloth media having a high level of irregularity due to fibers. When used in this manner, the toner of the present disclosure preferably comprises white toner particles, colorless toner particles (free of colorant), or a mixture thereof, so as not to impair the color of the toner superposed thereon.

[0071] Further, it is preferable that toner particles having a function of fixing on a cloth medium and having a peak in the range of from 12 to 16 μm are colorless toner particles.

Method for Manufacturing Toner

[0072] The method for manufacturing the toner according to an embodiment of the present invention is not particularly limited and can be suitably selected to suit to a particular application, and may include the following procedures. First, a binder resin, a colorant, and a release agent, optionally together with a charge controlling agent, are well mixed by a mixer such as HENSCHEL MIXER and SUPER MIXER.

[0073] The mixture is then melt-kneaded by a heat melt kneader such as a heat roll, a kneader, and an extruder, so that the materials are thoroughly mixed. The kneaded mixture is cooled to solidify, then pulverized into fine particles, and the fine particles are classified by size to obtain a toner.

[0074] The pulverizing process may be of a jet mill process in which a high-speed airflow incorporates toner particles to let the toner particles collide with a collision plate and be pulverized by the collision energy, an inter-particle collision process which lets toner particles collide with each other in an airflow, or a mechanical pulverizing process in which toner particles are supplied to a narrow gap formed with a rotor rotating at a high speed to be pulverized.

[0075] The toner according to an embodiment of the present invention may also be prepared by a dissolution suspension method. In this method, an oil phase is dispersed in an aqueous medium. Here, the oil phase comprises an organic solvent and toner materials dissolved or dispersed therein. After a reaction for forming a resin is conducted, removal of the solvent, filtration, washing, and drying are conducted, thus obtaining toner base particles.

Two-component Developer

[0076] The toner of the present disclosure may be mixed with a carrier to provide a two-component developer, which is used for an electrophotographic image forming method employing a two-component developing system.

[0077] When a two-component developing system is employed, fine particles of a magnetic material can be used as a magnetic carrier. Specific examples of the magnetic materials include, but are not limited to: magnetites; spinel ferrites containing gamma iron oxide; spinel ferrites containing at least one metal (e.g., Mn, Ni, Zn, Mg, and Cu) other than iron; magnetoplumbite-type ferrites such as barium ferrite; and particulate iron or alloy having an oxidized layer on its surface.

[0078] The magnetic material may be in any of granular, spherical, or needle-like shape.

[0079] When high magnetization is required, ferromagnetic fine particles, such as iron, are preferably used.

[0080] For chemical stability, magnetites, spinel ferrites containing gamma iron oxide, and magnetoplumbite-type ferrites such as barium ferrite are preferred. Specific preferred examples thereof include, but are not limited to, commercially available products such as MFL-35S and MFL-35HS (manufactured by Powdertech Co., Ltd.); and DFC-400M, DFC-410M, and SM-350NV (manufactured by Dowa IP Creation Co., Ltd.).

[0081] A resin carrier may also be used which has a desired magnetization by containing an appropriate type of magnetic fine particles in an appropriate amount. Such a resin carrier preferably has a magnetization strength of from 30 to 150 emu/g at 1,000 oersted. Such a resin carrier may be produced by spraying a melt-kneaded product of magnetic fine particles with an insulating binder resin by a spray dryer, or dispersing magnetic fine particles in a condensation-type binder resin by reacting/curing its monomer or prepolymer in an aqueous medium in the presence of magnetic fine particles. Chargeability of the magnetic carrier may be controlled by fixedly adhering positively-chargeable or negatively-chargeable fine particles or conductive fine particles to the surface of the magnetic carrier, or coating the magnetic carrier with a resin.

[0082] Examples of the surface coating resin include silicone resin, acrylic resin, epoxy resin, and fluorine-based resin. These resins may contain positively-chargeable or negatively-chargeable fine particles or conductive fine particles. Among these resins, silicone resin and acrylic resin are preferred.

[0083] The proportion of the carrier in the developer is preferably from 85% to 98% by mass. When the proportion is 85% by mass or higher, the toner is prevented from scattering from the developing device, thereby preventing the occurrence of defective images. When the proportion is 98% by mass or less, an excessive increase of the charge amount of the toner and shortage of the toner to be supplied can be prevented, thereby effectively preventing a decrease

of image density and the occurrence of defective images.

Toner Set

[0084] The toner set according to an embodiment of the present invention contains a base toner and a color toner.

[0085] The base toner is the above-described toner according to an embodiment of the present invention. The base toner preferably comprises colorless toner particles, white toner particles, or a mixture of white toner particles and colorless toner particles.

[0086] The color toner comprises a binder resin and a colorant.

[0087] The binder resin and the colorant may be the same as those used for the base toner as described above.

Toner Accommodating Unit

[0088] A toner accommodating unit according to an embodiment of the present invention is a unit accommodating the toner in a container having a function of accommodating toner. The toner accommodating unit may be in the form of, for example, a toner accommodating container, a developing device, or a process cartridge.

[0089] The toner accommodating container refers to a container accommodating the toner.

[0090] The developing device refers to a device accommodating the toner and having a developing unit configured to develop an electrostatic latent image into a toner image with the toner.

[0091] The process cartridge refers to a combined body of an image bearer with a developing unit accommodating the toner, detachably mountable on an image forming apparatus. The process cartridge may further include at least one of a charger, an irradiator, and a cleaner.

Image Forming Apparatus and Image Forming Method

[0092] An image forming apparatus according to an embodiment of the present invention includes: an electrostatic latent image bearer; a charger configured to charge the electrostatic latent image bearer; an irradiator configured to irradiate the charged electrostatic latent image bearer with light to form an electrostatic latent image; a developing device containing a developer containing a toner, configured to develop the electrostatic latent image with the developer to form a toner image; a transfer device configured to transfer the toner image formed on the electrostatic latent image bearer onto a recording medium; and a fixing device configured to fix the toner image on the recording medium. The image forming apparatus may further include other devices appropriately selected as necessary.

[0093] The image forming method according to an embodiment of the present invention can be suitably performed by the image forming apparatus according to an embodiment of the present invention.

[0094] The toner may comprise the toner according to an embodiment of the present invention or the toner set according to an embodiment of the present invention.

[0095] On the recording medium, it is preferable that the base toner image is transferred closer to the recording medium than the color toner image is. The base toner image may be formed closer to the recording medium as follows: transferring the color toner image onto a release paper sheet, then transferring the base toner image over the color toner image, placing the recording medium on the base toner image, applying a pressure from above the release paper sheet toward the recording medium (and raising the temperature) to fix the toner images on the recording medium, and removing the release paper sheet.

[0096] The recording medium is not particularly limited and may be appropriately selected to suit to a particular application. Specific examples of the recording medium include, but are not limited to, paper, thread, fiber, cloth, leather, metal, plastic, glass, wood, ceramics, and composite materials thereof. Examples of the cloth include, but are not limited to, uniforms, shoes, and bags.

[0097] FIG. 1 is a schematic diagram illustrating an image forming apparatus according to an embodiment of the present invention. The image forming apparatus illustrated in FIG. 1 includes five toner image forming units 20Y, 20C, 20M, 20K, and 20A accommodating yellow, cyan, magenta, black, and white toners, respectively, arranged in parallel. This image forming apparatus is a tandem image forming apparatus in which toner images of yellow (Y), cyan (C), magenta (M), black (K), and white (A) respectively formed in the five toner image forming units are superimposed to form a full-color image. There is no particular limitation on the arrangement order of the toner image forming units for each color.

[0098] The toner image forming units 20Y, 20C, 20M, 20K, and 20A respectively include photoconductor drums 4Y, 4C, 4M, 4K, and 4A as image bearers that are driven to rotate. The image forming apparatus further includes an irradiator 45 configured to irradiate the photoconductor drums 4Y, 4C, 4M, 4K, and 4A with laser light or LED (light emitting diode) light based on image information of each color to form latent images thereon.

[0099] An intermediate transfer belt 60 as an intermediate transferor, the surface of which is movable, is disposed so

as to face the toner image forming units 20Y, 20C, 20M, 20K, and 20A. Primary transfer rollers 61Y, 61C, 61M, 61K and 61A are disposed facing the respective photoconductor drums 4Y, 4C, 4M, 4K, and 4A via the intermediate transfer belt 60 to transfer the toner images formed on the respective photoconductor drums 4Y, 4C, 4M, 4K, and 4A onto the intermediate transfer belt 60.

[0100] The primary transfer rollers 61Y, 61C, 61M, 61K, and 61A sequentially transfer the toner images formed in the toner image forming units 20Y, 20C, 20M, 20K, and 20A, described in detail later, onto the intermediate transfer belt 60 to form a full-color image by superimposition.

[0101] A secondary transfer device 65 that collectively transfers the toner images on the intermediate transfer belt 60 onto a transfer sheet is disposed downstream of the primary transfer rollers 61Y, 61C, 61M, 61K, and 61A in the direction of surface movement of the intermediate transfer belt 60. Further, a belt cleaner 66 that removes toner remaining on the surface of the intermediate transfer belt 60 is disposed downstream of the secondary transfer device 65.

[0102] A sheet feeder 70 including a sheet tray 71 and a feed roller 72 is disposed on a lower part of the image forming apparatus. The sheet feeder 70 sends out a transfer sheet toward a registration roller pair 73. The registration roller pair 73 sends out the transfer sheet toward the position where the intermediate transfer belt 60 and the secondary transfer device 65 are facing in synchronization with an entry of the toner image to that position. The full-color toner image on the intermediate transfer belt 60 is transferred onto the transfer sheet by the secondary transfer device 65, fixed on the transfer sheet by a fixing device 90, and ejected outside the image forming apparatus.

[0103] Next, each of the toner image forming units 20Y, 20C, 20M, 20K, and 20A is described in detail below. Each of the toner image forming units 20Y, 20C, 20M, 20K, and 20A has almost the same configuration and operates in the same manner except for accommodating different color toners. Hereinafter, the configuration and operation of each toner image forming unit are described referring to a toner image forming unit 20 from which the suffix Y, C, M, K, or A has been omitted. FIG. 2 is a schematic diagram illustrating a main part of the image forming apparatus.

[0104] In the toner image forming unit 20, various devices for performing an electrophotographic process are disposed around a photoconductor drum 4, such as a charger 40, a developing device 50, and a cleaner 30. The toner image forming unit 20 forms a toner image on the photoconductor drum 4 by a conventional operation. The toner image forming unit 20 may be in the form of a process cartridge that is detachably mounted on the image forming apparatus main body.

[0105] FIG. 3 is a schematic diagram illustrating a main part of an image forming apparatus according to an embodiment of the present invention, including five developing devices. The description of the same parts as those of the above-described image forming apparatus is omitted.

[0106] This image forming apparatus includes photoconductors 5, 11, 17, 23, and 29, around which respective chargers 6, 12, 18, 24, and 130, respective developing devices 8, 14, 120, 26, and 32, respective transfer devices 10, 16, 22, 28, and 34, and respective cleaners 9, 15, 21, 27, 33 are disposed. The photoconductors 5, 11, 17, 23, and 29 are irradiated with exposure light 7, 13, 19, 25, and 31, respectively.

[0107] A developing unit for each color includes the corresponding photoconductor, charger, developing device, and cleaner. Developing units 35, 36, 37, 38, and 39 respectively form images with white toner, black toner, cyan toner, magenta toner, and yellow toner, and the images are transferred onto an intermediate transfer belt 140. The images formed on the intermediate transfer belt 40 are transferred onto a recording medium by a transfer device 41 and fixed thereon by a fixing device 43.

EXAMPLES

[0108] Having generally described this invention, further understanding can be obtained by reference to certain specific examples which are provided herein for the purpose of illustration only and are not intended to be limiting. In the following descriptions, "parts" represents "parts by mass" unless otherwise specified.

Example 1

Toner Raw Materials of Toner 1

[0109]

Adhesive agent PES-111EE (manufactured by Toagosei Co., Ltd.): 20 parts
Polyester resin RN-290 (manufactured by Kao Corporation): 75 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

[0110] The toner raw materials listed above were preliminarily mixed using a HENSCHEL MIXER (FM20B manufactured by NIPPON COKE & ENGINEERING CO., LTD.) and melt-kneaded using a single-shaft kneader (BUSS CO-

KNEADER manufactured by Buss AG) at a temperature of from 100 to 130 degrees C. The kneaded product was cooled to room temperature and coarsely pulverized using a ROTOPLEX to have a diameter of from 200 to 300 μm. The resulted particles were further finely pulverized using a COUNTER JET MILL (100AFG manufactured by Hosokawa Micron Corporation) to have a predetermined number average particle diameter while appropriately adjusting the pulverization air pressure. The resulted particles were classified by size using an air classifier (EJ-LABO manufactured by MATSUBO Corporation) to have a predetermined number average particle diameter distribution while appropriately adjusting the opening of the louver. Thus, toner base particles were prepared. Next, 100 parts of the toner base particles were stir-mixed with additives including 1.0 part of HDK-2000 and 1.0 part of H05TD, both manufactured by Clariant, using a HENSCHEL MIXER. Thus, a toner 1 was prepared.

Example 2

[0111] A toner of Example 2 was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Toner Raw Materials of Example 2

[0112]

Adhesive agent PES-111EE (manufactured by Toagosei Co., Ltd.): 10 parts
Polyester resin RN-290 (manufactured by Kao Corporation): 85 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

Example 3

[0113] A toner of Example 3 was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Toner Raw Materials of Example 3

[0114]

Adhesive agent PES-111EE (manufactured by Toagosei Co., Ltd.): 50 parts
Polyester resin RN-290 (manufactured by Kao Corporation): 45 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

Examples 4 to 7

[0115] Toners of Examples 4 to 7 were prepared in the same manner as in Example 1 except that the pulverization/classification conditions were changed such that the peaks in the particle size distribution were as presented in Tables 1-1 and 1-2.

Comparative Example 1

[0116] A toner of Comparative Example 1 was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Toner Raw Materials of Comparative Example 1

[0117]

Polyester resin RN-290 (manufactured by Kao Corporation): 95 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

Comparative Example 2

[0118] A toner of Comparative Example 2 was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Toner Raw Materials of Comparative Example 2

[0119]

Adhesive agent PES-111EE (manufactured by Toagosei Co., Ltd.): 8 parts
Polyester resin RN-290 (manufactured by Kao Corporation): 87 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

Comparative Example 3

[0120] A toner of Comparative Example 3 was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Toner Raw Materials of Comparative Example 3

[0121]

Adhesive agent PES-111EE (manufactured by Toagosei Co., Ltd.): 60 parts
Polyester resin RN-290 (manufactured by Kao Corporation): 35 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Titanium oxide PF-739 (manufactured by Ishihara Sangyo Kaisha, Ltd.): 65 parts

Raw Materials of Color Toner

[0122] A color toner was prepared in the same manner as in Example 1 except that the toner raw materials were replaced with the following materials.

Polyester resin RN-290 (manufactured by Kao Corporation): 35 parts
Ester wax WEP-5 (manufactured by NOF Corporation): 5 parts
Colorant TOSHIKIRED 1022 (manufactured by DIC Corporation): 6 parts

Measurement of Glass Transition Temperature

[0123] The glass transition temperatures of the toners prepared in Examples 1-7 and Comparative Examples 1-3 were measured using a differential scanning calorimeter (DSC210 manufactured by Seiko Instruments & Electronics Ltd.) in the following manner. The measurement results are presented in Tables 1-1 and 1-2.

[0124] First, 0.01 to 0.02 g of each toner was weighed in an aluminum pan at room temperature, then cooled to -20 degrees C at a temperature falling rate of 10 degrees C/min, and heated to 200 degrees C at a temperature rising rate of 10 degrees C/min. The glass transition temperature (Tg) was determined as a temperature at the intersection of an extended line of a base line of the resulted endothermic curve, and a tangent line of the endothermic curve which indicated the maximum slope between the peak rising portion and the peak top.

Measurement of Number-Based Particle Diameter Distribution

[0125] The number-based particle diameter distributions of the toners prepared in Examples 1-7 and Comparative Examples 1-3 were measured using a particle size analyzer (MULTISIZER III manufactured by Beckman Coulter, Inc.). The measurement results are presented in Tables 1-1 and 1-2.

[0126] The measurement was performed by setting the aperture diameter to 100 μm and the analysis was performed using an analysis software program (Beckman Colter Multisizer 3 Version 3.51). Specifically, 0.5 mL of a 10% by mass aqueous solution of a surfactant (an alkylbenzene sulfonate, NEOGEN SC-A manufactured by DKS Co., Ltd.) was put in a 100-mL glass beaker, then 0.5 g of the toner was added thereto and mixed using a micro spatula, and 80 mL of ion-exchange water was further added thereto. The resulting dispersion liquid was subjected to a dispersion treatment

using an ultrasonic disperser (W-113MK-II manufactured by HONDA ELECTRONICS CO., LTD.) for 10 minutes. The dispersion liquid was measured using the MULTISIZER III and ISOTON III (manufactured by Beckman Coulter, Inc.) as a solution for measurement. In the measurement, the toner sample dispersion liquid was dropped so that the concentration indicated by the apparatus became 8±2%.

Production of Two-component Developer

Preparation of Carrier

[0127]

- Silicone resin (Organo straight silicone): 100 parts
- Toluene: 100 parts
- γ-(2-Aminoethyl) aminopropyl trimethoxysilane: 5 parts
- Carbon black: 10 parts

[0128] The above materials were dispersed by a homomixer for 20 minutes to prepare a coating layer forming liquid. Manganese (Mn) ferrite particles having a weight average particle diameter of 35 μm as core materials were coated with the coating layer forming liquid using a fluidized bed coating device while controlling the temperature inside the fluidized bed to 70 degrees C, followed by drying, so that the coating layer was formed on the surface of the core materials with an average film thickness of 0.20 μm. The core materials having the coating layer were burnt in an electric furnace at 180 degrees C for 2 hours. Thus, a carrier A was prepared.

Preparation of Two-component Developer

[0129] Each of the toners prepared in Examples 1-7 and Comparative Examples 1-3 (white toners) and the color toner was uniformly mixed with the carrier A using a TURBULA MIXER (manufactured by Willy A. Bachofen AG (WAB)) at a revolution of 48 rpm for 5 minutes to be charged. Thus, each two-component developer was prepared. The mixing ratio of the toner to the carrier was 7% by mass, which was equal to the initial toner concentration in the developer in the test machine.

Evaluation Methods

Image Production Conditions

[0130] An image was produced using an image forming apparatus (RICOH Pro C7200S manufactured by Ricoh Co., Ltd.) by the following procedure. Each of the toners prepared in Examples 1-7 and Comparative Examples 1-3 was set in the 5th station of the image forming apparatus.

[0131] First, a magenta unfixed solid image was output on a release paper sheet under the development and transfer conditions adjusted by the process controller such that the toner deposition amount became 0.40 mg/cm^2.

[0132] Next, an unfixed solid image of each of the toners of Examples 1-7 and Comparative Examples 1-3 was output superimposed on the magenta unfixed solid image on the release paper sheet, under the development and transfer conditions adjusted by the process controller such that the toner deposition amount became 1.0 mg/cm^2.

[0133] A cloth material made of 100% polyester was superimposed on each toner image of Examples 1-7 and Comparative Examples 1-3, and an iron at 160 degrees C was applied thereto for 10 seconds to thermally transfer the toner to the cloth material. Thus, a fixed image was obtained.

Image Unevenness

[0134] The obtained fixed image was visually observed to evaluate the degree of image unevenness according to the following evaluation criteria. The evaluation results are presented in Tables 1-1 and 1-2.

Evaluation Criteria

[0135]

A: No color unevenness is observed in the image.
B: A light image portion is observed.

C: A light image portion due to irregularities of the fibers of the cloth is recognized.

Washing Fastness

[0136] The fixed image obtained for evaluating image unevenness was subjected to a washing fastness test based on the test method according to JIS (Japanese Industrial Standards) 0844:2011 ("Test methods for colour fastness to washing and laundering"), and washing fastness was evaluated based on the following evaluation criteria. The evaluation results are presented in Tables 1-1 and 1-2.

Evaluation Criteria

[0137]

A: Grey scale for assessing change in color in JIS 0844 is Rank 5
B: Grey scale for assessing change in color in JIS 0844 is Rank 4 to 3
C: Grey scale for assessing change in color in JIS 0844 is Rank 2 to 1

Blocking Resistance

[0138] The fixed images obtained for evaluating image unevenness were superimposed on one another so that the image portions, or the image portion and the non-image portion, came to face each other. The superimposed portion was applied with a pressure of 80 g/cm^2 by a weight placed whereon, then left to stand for one day in a high-temperature high-humidity tank at 55 degrees C and a relative humidity of 50%. After being left to stand, each of the two superimposed fixed images was visually observed to judge the degree of image defects, and blocking resistance was evaluated based on the following evaluation criteria. The evaluation results are presented in Tables 1-1 and 1-2.

Evaluation Criteria

[0139]

A: No image transfer is observed in both the image portion and the non-image portion.

B: Image transfer is partially observed.

C: The two superimposed fixed images are adhered and cannot be peeled off. When they are forcibly peeled off, the fixed image together with the surface layer of paper is peeled off, resulting in significant image defect.

Table 1-2

		Examples						
		1	2	3	4	5	6	7
Toner Raw Materials (parts)	PES-111EE	20	10	50	20	20	20	20
	RN-290	75	85	45	75	75	75	75
	WEP-5	5	5	5	5	5	5	5
	PF-739	65	65	65	65	65	65	65
Toner Properties	Glass Transition Temperature (deg. C)	0	5	-5	0	0	0	0
	Number of Particle Diameter Peaks	2	2	2	1	1	2	2
	Peak Position (μm)	7, 13	5, 12	8, 16	7	13	7, 10	9, 13
	Peak in 12-16 μm	Present	Present	Present	None	Present	None	Present
	Peak in 5-8 μm	Present	Present	Present	Present	None	Present	None

(continued)

		Examples						
		1	2	3	4	5	6	7
Evaluation Results	Image Unevenness	A	A	A	B	B	B	B
	Washing Fastness	A	B	A	B	B	B	B
	Blocking Resistance	A	A	B	B	B	A	A

Table 1-2

		Comparative Examples		
		1	2	3
Toner Raw Materials (parts)	PES-111EE	0	8	60
	RN-290	95	87	35
	WEP-5	5	5	5
	PF-739	65	65	65
Toner Properties	Glass Transition Temperature (deg. C)	60	10	-8
	Number of Particle Diameter Peaks	2	2	2
	Peak Position (μm)	7, 13	7, 13	7, 13
	Peak in 12-16 μm	Present	Present	Present
	Peak in 5-8 μm	Present	Present	Present
Evaluation Results	Image Unevenness	A	A	A
	Washing Fastness	C	C	A
	Blocking Resistance	A	A	C

[0140] Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

Claims

1. A toner comprising a binder resin and an adhesive agent,

wherein the toner has a glass transition temperature of -5 degrees C or higher and 5 degrees C or lower;
wherein the toner contains at least one adhesive agent selected from polyethylene terephthalate, polyethylene isophthalate, polybutylene terephthalate, and polybutylene isophthalate; and
wherein the glass transition temperature (Tg) is measured according to the description.

2. The toner according to claim 1, wherein a number-based particle diameter distribution of the toner has at least two peaks; and wherein the number-based particle diameter distribution is measured according to the description.

3. The toner according to claim 2, wherein the at least two peaks include a peak in a number-based particle diameter range of from 12 to 16 μm and another peak in a number-based particle diameter range of from 5 to 8 μm.

4. The toner according to any one of claims 1 to 3, wherein the toner comprises at least one of colorless toner particles and white toner particles.

5. The toner according to claim 4, wherein a number-based particle diameter distribution of the toner has a peak in a number-based particle diameter range of from 12 to 16 μm, and the peak is derived from the colorless toner particles.

6. A toner set comprising:

a base toner comprising the toner according to any one of claims 1 to 5; and
a color toner comprising a binder resin and a colorant.

7. A toner accommodating unit comprising:

a container; and
the toner according to any one of claims 1 to 5 accommodated in the container.

8. An image forming apparatus comprising:

an electrostatic latent image bearer (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29);
a charger (40; 6; 12; 18; 24; 130) configured to charge the electrostatic latent image bearer (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29);
an irradiator (45) configured to irradiate the charged electrostatic latent image bearer (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29) with light to form an electrostatic latent image;
a developing device (50; 8; 14; 120; 26; 32) containing a developer containing the toner according to any one of claims 1 to 5, the developing device (50; 8; 14; 120; 26; 32) configured to develop the electrostatic latent image with the developer to form a toner image;
a transfer device (61Y; 61C; 61M; 61K; 61A; 65; 10; 16; 22; 28; 34; 41) configured to transfer the toner image formed on the electrostatic latent image bearer (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29) onto a recording medium; and
a fixing device (90; 43) configured to fix the toner image on the recording medium.

9. An image forming method comprising:

charging an electrostatic latent image bearer;
irradiating the charged electrostatic latent image bearer with light to form an electrostatic latent image;
developing the electrostatic latent image with a developer containing the toner according to any one of claims 1 to 5 to form a toner image;
transferring the toner image formed on the electrostatic latent image bearer onto a recording medium; and
fixing the toner image on the recording medium.

10. The image forming method according to claim 9,

wherein the developing includes:
developing the electrostatic latent image with a base developer containing a base toner to form a base toner image and with a color developer containing a color toner to form a color toner image, the base toner comprising the toner according to any one of claims 1 to 5 and the color toner comprising a binder resin and a colorant;
wherein the transferring includes:
transferring the base toner image and the color toner image formed on the electrostatic latent image bearer onto the recording medium; and
wherein the fixing includes:
fixing the base toner image and the color toner image on the recording medium.

11. The image forming method according to claim 10, wherein, in the transferring, the base toner image is transferred closer to the recording medium than the color toner image is.

Patentansprüche

1. Toner, der ein Bindemittelharz und ein Klebemittel umfasst,

   wobei der Toner eine Glasübergangstemperatur von -5 Grad C oder höher und 5 Grad C oder niedriger aufweist;
   wobei der Toner mindestens ein Klebemittel, ausgewählt aus Polyethylenterephthalat, Polyethylenisophthalat, Polybutylenterephthalat und Polybutylenisophthalat, enthält; und
   wobei die Glasübergangstemperatur (Tg) gemäß der Beschreibung gemessen wird.

2. Toner nach Anspruch 1, wobei eine anzahlbasierte Teilchendurchmesserverteilung des Toners mindestens zwei Spitzen aufweist; und wobei die anzahlbasierte Teilchendurchmesserverteilung gemäß der Beschreibung gemessen wird.

3. Toner nach Anspruch 2, wobei die mindestens zwei Spitzen eine Spitze in einem anzahlbasierten Teilchendurchmesserbereich von 12 bis 16 μm und eine weitere Spitze in einem anzahlbasierten Teilchendurchmesserbereich von 5 bis 8 μm einschließen.

4. Toner nach einem der Ansprüche 1 bis 3, wobei der Toner mindestens eines von farblosen Tonerteilchen und weißen Tonerteilchen umfasst.

5. Toner nach Anspruch 4, wobei eine anzahlbasierte Teilchendurchmesserverteilung des Toners eine Spitze in einem anzahlbasierten Teilchendurchmesserbereich von 12 bis 16 μm aufweist und die Spitze von den farblosen Tonerteilchen abgeleitet ist.

6. Tonersatz, der Folgendes umfasst:

   einen Basistoner, der den Toner nach einem der Ansprüche 1 bis 5 umfasst; und
   einen Farbtoner, der ein Bindemittelharz und ein Farbmittel umfasst.

7. Toneraufnahmeeinheit, die Folgendes umfasst:

   einen Behälter; und
   den Toner nach einem der Ansprüche 1 bis 5, in dem Behälter aufgenommen.

8. Bilderzeugungsvorrichtung, die Folgendes umfasst:

   einen elektrostatischen Latentbildträger (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29);
   ein Ladegerät (40; 6; 12; 18; 24; 130), das zum Laden des elektrostatischen Latentbildträgers (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29) konfiguriert ist;
   einen Bestrahler (45), der zum Bestrahlen des geladenen elektrostatischen Latentbildträgers (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29) mit Licht konfiguriert ist, um ein elektrostatisches Latentbild zu erzeugen;
   eine Entwicklungsvorrichtung (50; 8; 14; 120; 26; 32), die einen Entwickler enthält, der den Toner nach einem der Ansprüche 1 bis 5 enthält, wobei die Entwicklungsvorrichtung (50; 8; 14; 120; 26; 32) zum Entwickeln des elektrostatischen Latentbildes mit dem Entwickler konfiguriert ist, um ein Tonerbild zu erzeugen;
   eine Übertragungsvorrichtung (61Y; 61C; 61M; 61K; 61A; 65; 10; 16; 22; 28; 34; 41), die zum Übertragen des auf dem elektrostatischen Latentbildträger (4Y; 4C; 4M; 4K; 4A; 4; 5; 11; 17; 23; 29) erzeugten Tonerbildes auf ein Aufzeichnungsmedium konfiguriert ist; und
   eine Fixiervorrichtung (90; 43), die zum Fixieren des Tonerbildes auf dem Aufzeichnungsmedium konfiguriert ist.

9. Bilderzeugungsverfahren, das Folgendes umfasst:

   Laden eines elektrostatischen Latentbildträgers;
   Bestrahlen des geladenen elektrostatischen Latentbildträgers mit Licht, um ein elektrostatisches Latentbild zu erzeugen;
   Entwickeln des elektrostatischen Latentbildes mit einem Entwickler, der den Toner nach einem der Ansprüche 1 bis 5 enthält, um ein Tonerbild zu erzeugen;
   Übertragen des auf dem elektrostatischen Latentbildträger erzeugten Tonerbildes auf ein Aufzeichnungsmedium; und

Fixieren des Tonerbildes auf dem Aufzeichnungsmedium.

10. Bilderzeugungsverfahren nach Anspruch 9,
wobei das Entwickeln Folgendes einschließt:

Entwickeln des elektrostatischen Latentbildes mit einem Basisentwickler, der einen Basistoner enthält, um ein Basistonerbild zu erzeugen, und mit einem Farbentwickler, der einen Farbtoner enthält, um ein Farbtonerbild zu erzeugen, wobei der Basistoner den Toner nach einem der Ansprüche 1 bis 5 umfasst und der Farbtoner ein Bindemittelharz und ein Farbmittel umfasst;
wobei das Übertragen Folgendes einschließt:

Übertragen des Basistonerbildes und des Farbtonerbildes, die auf dem elektrostatischen Latentbildträger erzeugt werden, auf das Aufzeichnungsmedium; und
wobei das Fixieren Folgendes einschließt:
Fixieren des Basistonerbildes und des Farbtonerbildes auf dem Aufzeichnungsmedium.

11. Bilderzeugungsverfahren nach Anspruch 10, wobei beim Übertragen das Basistonerbild näher an das Aufzeichnungsmedium übertragen wird als das Farbtonerbild.

Revendications

1. Toner comprenant une résine liante et un agent adhésif,

dans lequel le toner présente une température de transition vitreuse égale ou supérieure à -5 degrés C et inférieure ou égale à 5 degrés C ;
dans lequel le toner contient au moins un agent adhésif sélectionné parmi le téréphtalate de polyéthylène, l'isophtalate de polyéthylène, le téréphtalate de polybutylène et l'isophtalate de polybutylène ; et
dans lequel la température de transition vitreuse (Tg) est mesurée selon la description.

2. Toner selon la revendication 1, dans lequel une distribution de diamètre de particules basé sur le nombre du toner présente au moins deux pics ; et dans lequel la distribution de diamètre de particules basé sur le nombre du toner est mesurée selon la description.

3. Toner selon la revendication 2, dans lequel les au moins deux pics incluent un pic dans une plage de diamètre de particule basé sur le nombre de 12 à 16 μm et un autre pic dans une plage de diamètre de particule basé sur le nombre de 5 à 8 μm.

4. Toner selon l'une quelconque des revendications 1 à 3, dans lequel le toner comprend au moins un parmi des particules de toner incolores et des particules de toner blanches.

5. Toner selon la revendication 4, dans lequel une distribution de diamètre de particules basé sur le nombre du toner présente un pic dans une plage de diamètre de particule basé sur le nombre de 12 à 16 μm et le pic est dérivé à partir des particules de toner incolores.

6. Ensemble de toner comprenant :

un toner de base comprenant le toner selon l'une quelconque des revendications 1 à 5 ; et
un toner de couleur comprenant une résine liante et un colorant.

7. Unité de logement de toner comprenant :

un récipient ; et
le toner selon l'une quelconque des revendications 1 à 5 logé dans le récipient.

8. Appareil de formation d'image comprenant :

un support d'image latente électrostatique (4Y ; 4C ; 4M ; 4K ; 4A ; 4 ; 5 ; 11 ; 17 ; 23 ; 29) ;

un chargeur (40 ; 6 ; 12 ; 18 ; 24 ; 130) configuré pour charger le support d'image latente électrostatique (4Y ; 4C ; 4M ; 4K ; 4A ; 4 ; 5 ; 11 ; 17 ; 23 ; 29) ;
un irradiateur (45) configuré pour irradier le support d'image latente électrostatique chargé (4Y ; 4C ; 4M ; 4K ; 4A ; 4 ; 5 ; 11 ; 17 ; 23 ; 29) avec de la lumière pour former une image latente électrostatique ;
un dispositif de développement (50 ; 8 ; 14 ; 120 ; 26 ; 32) contenant un développeur contenant le toner selon l'une quelconque des revendications 1 à 5, le dispositif de développement (50 ; 8 ; 14 ; 120 ; 26 ; 32) étant configuré pour développer l'image latente électrostatique avec le développeur pour former une image de toner ;
un dispositif de transfert (61Y ; 61C ; 61M ; 61K ; 61A ; 65 ; 10 ; 16 ; 22 ; 28 ; 34 ; 41) configuré pour transférer l'image de toner formée sur le support d'image latente électrostatique (4Y ; 4C ; 4M; 4K ; 4A ; 4 ; 5 ; 11 ; 17 ; 23 ; 29) sur un support d'enregistrement ; et
un dispositif de fixation (90 ; 43) configuré pour fixer l'image de toner sur le support d'enregistrement.

9. Procédé de formation d'image, comprenant :

le chargement d'un support d'image latente électrostatique ;
l'irradiation du support d'image latente électrostatique chargé avec de la lumière pour former une image latente électrostatique ;
le développement de l'image latente électrostatique avec un développeur contenant le toner selon l'une quelconque des revendications 1 à 5 pour former une image de toner ;
le transfert de l'image de toner formée sur le support d'image latente électrostatique sur un support d'enregistrement ; et
la fixation de l'image de toner sur le support d'enregistrement.

10. Procédé de formation d'image selon la revendication 9,
dans lequel le développement inclut :

le développement de l'image latente électrostatique avec un développeur de base contenant un toner de base pour former une image de toner de base et avec un développeur de couleur contenant un toner de couleur pour former une image de toner de couleur, le toner de base comprenant le toner selon l'une quelconque des revendications 1 à 5 et le toner de couleur comprenant une résine liante et un colorant ;
dans lequel le transfert inclut :

le transfert de l'image de toner de base et de l'image de toner de couleur formées sur le support d'image latente électrostatique sur le support d'enregistrement ; et
dans lequel la fixation inclut :
la fixation de l'image de toner de base et de l'image de toner de couleur sur le support d'enregistrement.

11. Procédé de formation d'image selon la revendication 10, dans lequel, dans le transfert, l'image de toner de base est transférée plus près du support d'enregistrement que l'image de toner de couleur ne l'est.

FIG. 1

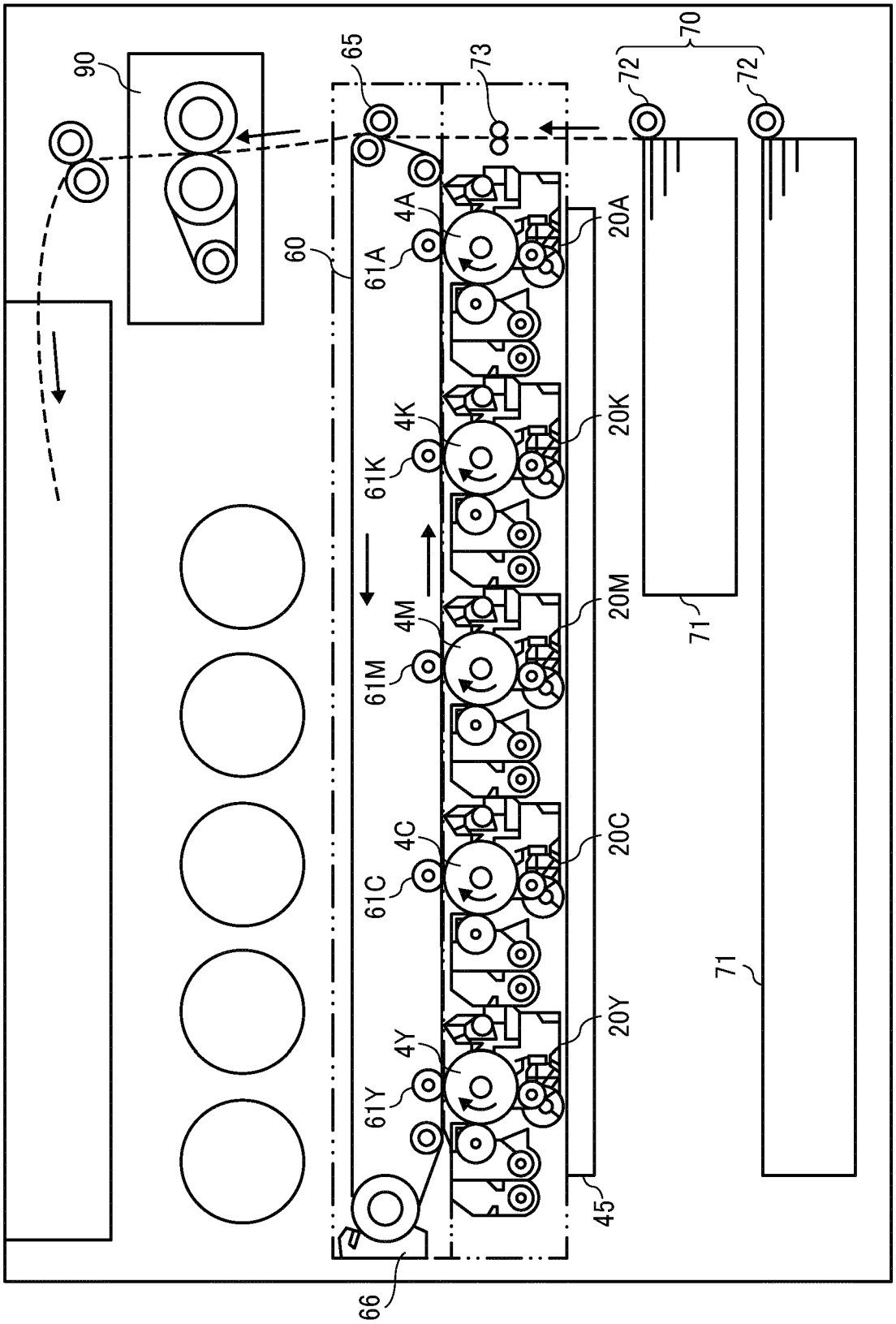

90
65
73
70
72
72
60
61A
4A
20A
4K
61K
20K
4M
61M
20M
71
4C
61C
20C
71
4Y
61Y
20Y
45
66

FIG. 2

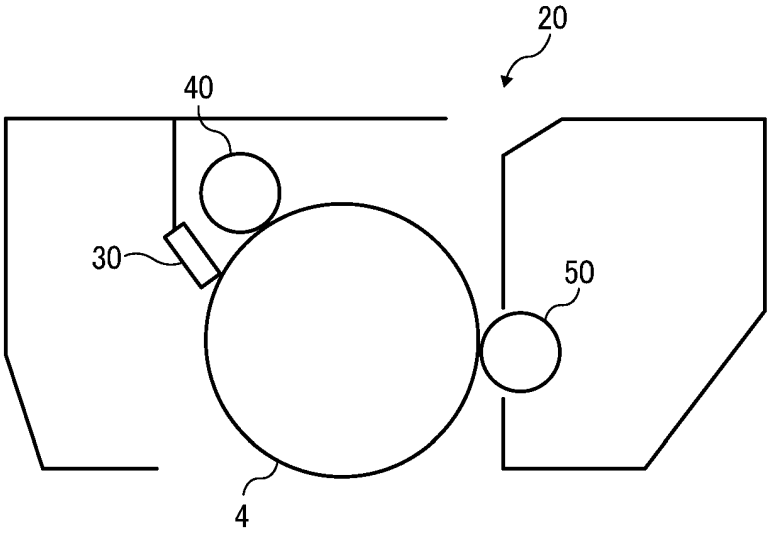
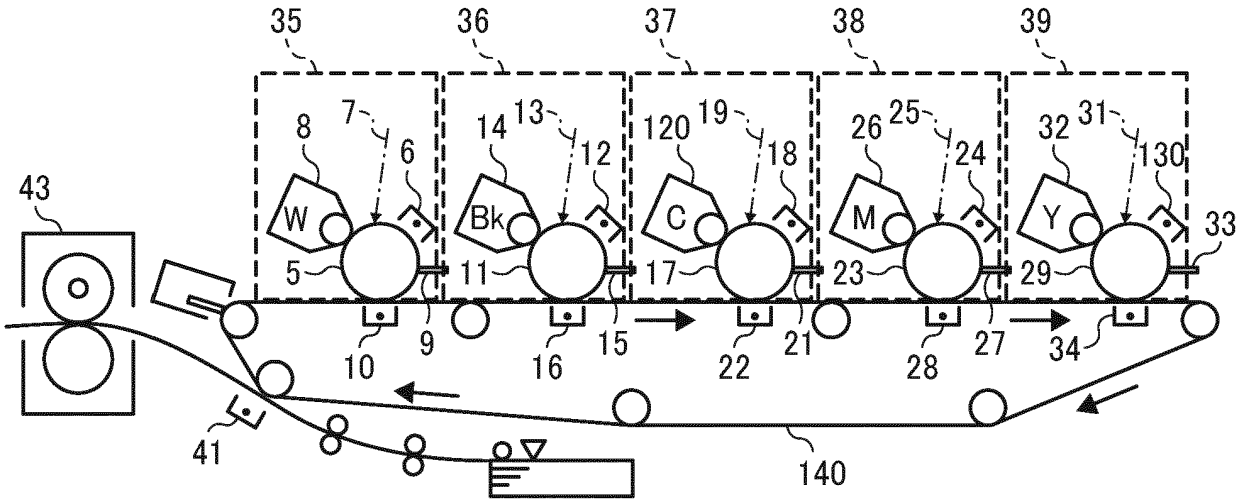

20
40
30
50
4

FIG. 3


35
36
37
38
39
43
8
7
6
14
13
12
120
19
18
26
25
24
32
31
130
33
W
Bk
C
M
Y
5
11
17
23
29
10
9
16
15
22
21
28
27
34
41
140

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2004051753 A **[0005] [0007]**